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**WASTEWATER TREATMENT PLANT ENVIRONMENTAL STUDY,
SHAW AIR FORCE BASE, SOUTH CAROLINA**

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PREFACE

This report is a record of actions taken at Shaw Air Force Base, South Carolina, under the Wastewater Treatment Plant Environmental Study Program for the purpose of improving the performance of the wastewater treatment plant serving that installation.

During Phase III of the project, an on-site visit was made at Shaw AFB by a senior operations specialist from Parsons Engineering Science, Inc. During the on-site visit, plant operations were reviewed to ascertain the effectiveness of previous phases of the program, to determine the current status of previous recommendations and to evaluate and determine overall effectiveness of the program.

EXECUTIVE SUMMARY

The Wastewater Treatment Plant Environmental Study Program is a major program designed to correct operational and maintenance shortcomings at U.S. Air Force wastewater treatment plants. This is a three-phase program, as outlined below:

- Phase I--On-site diagnostic evaluation of a plant to identify shortcomings and determine what assistance is needed to correct them.
- Phase II--Preparation of a plant-specific Operation and Maintenance Manual and on-site implementation and support for improving O&M, and/or sampling and laboratory analyses.
- Phase III--On-site follow-up evaluation to assess the effectiveness of assistance provided during Phase I and Phase II.

The Phase I visit was conducted April 25-29, 1994 by Mike Hewitt and Charles Baylot of Parsons Engineering Science. A total of 36 recommendations were made as a result of the Phase I visit. These recommendations were made to optimize the operation of the WWTP and to ensure compliance with Nation Pollutant Discharge Elimination System Permit (NPDES) in a cost-effective manner. A summary of all Phase I recommendations is provided in Section 2 of this report.

The Phase II on-site visits were conducted over a five month period between July 1994 and December 1994. The dates and Parsons ES team members conducting these site visits are as follows:

July 11-12, 1994	Mike Hewitt
September 22-23, 1994	Mike Hewitt
October 24-25, 1994	Mike Hewitt
December 1-2, 1994	Mike Hewitt

During each of the on-site visits, the status of all previous recommendations was updated, assistance was provided to implement recommendations; and activities related to preparations and validation of the O&M Manual contents were performed. The draft O&M Manual was delivered to the Base on October 30, 1994. Section 3 of this report provides documentation on the status of the project during Phase II.

The Phase III on-site visit was conducted on January 18-20, 1995 by Mike Hewitt of Parsons Engineering Science, Inc. During this visit an overall reassessment of the plant O&M was made, the progress toward implementation of recommendations was

evaluated, additional assistance, particularly with regard to plant process control was provided, and the benefits accrued as the result of the WWTP Environmental Study Program were assessed. Section 4 of this report documents the activities of the Phase III visit.

At the time of the Phase III visit, the WWTP operation had greatly improved. Plant personnel had fully implemented a process control strategy for the plant and the plant performance had improved dramatically since the inception of the project. The process control and performance improvements are directly attributable to the increased interest and attention being paid to the plant by operational personnel and their implementation of the study recommendations.

The format of the Phase III report generally follows that provided in "A Guide to the Department of Defense Operation, Maintenance and Training Assistance Program (OMTAP) for Wastewater Treatment Plant Personnel," June 1987.

SECTION 1

INTRODUCTION

1.1 DESCRIPTION OF OMTAP

The Wastewater Treatment Plant Environmental Study Program is a Department of Defense program designed to improve the performance of wastewater treatment plants located on military installations. The program is divided into three phases, each requiring visits to the treatment facility by one or more evaluators.

The first phase (Diagnostic Phase) involves a comprehensive diagnostic evaluation of the treatment plant or laboratory to identify deficiencies in operation or design. During this site visit, the evaluation team members conduct a comprehensive process or laboratory evaluation and collect information needed to produce a draft of an operation and maintenance manual. Reviews of all pertinent procedures are performed on site. Evaluation of plant and/or laboratory records are also conducted.

The second phase (Assistance Phase) involves up to four site visits to provide implementation and support for operators and/or laboratory personnel on procedures recommended to overcome those problems identified during the diagnostic phase. The visits occur several months after the program is in process at an Air Force installation. The team also validates the content of the draft O&M manual and examines operational and procedural problems in more depth.

The third phase (Verification Phase) which occurs 8 to 12 months after the initial visit is a follow-up verification of plant or lab performance to assess those improvements that have been made since the program's inception and the benefits accrued. If needed, additional assistance that might benefit the operators or the lab personnel is provided.

1.2 PURPOSE AND ACTIVITIES OF PHASE III VISIT

The Shaw AFB WWTP Environmental Study, Phase III on-site visit was conducted February 1-3, 1995 by Mike Hewitt of Parsons Engineering Science, Inc. (Parsons ES). Mike Hewitt traveled to Sumter, South Carolina on January 31, 1995 and arrived at Shaw AFB at 0800 hours on February 1, 1995. In addition to re-evaluating plant operations and verifying the status of project recommendations, the Parsons ES project manager held meetings and informal discussions with the WWTP NCOIC and plant personnel on operational issues in an attempt to continue operator input into the program. A meeting was held with SMSgt. Peter Navin at 0830 hours to begin reviewing progress made toward implementing project recommendations since the last site visit. A second meeting was held with SMSgt. Navin in this regard on February 2, 1995 at approximately 1030 hours. The remainder of February 1 and 2, 1995 were spent

reviewing process operations data including calculated values in the process spreadsheet, collecting all discharge data for the previous twelve months and assessing plant operation and performance. On the morning of February 3, 1995 evaluation and data collection activities continued.

On February 3, 1995 at 1330 hours an outbriefing meeting was conducted at the Base Civil Engineering Squadron to provide a summary of activities conducted during the Phase III Visit and present preliminary findings and recommendations. A summary of the outbriefing was presented at the outbriefing and included with project letter report No. 7.

SECTION 2

DIAGNOSTIC PHASE SUMMARY

2.1 SUMMARY OF SITE VISIT

The Phase I visit was conducted to perform an on-site diagnostic evaluation of the Shaw Air Force Base wastewater treatment plant (WWTP). The purpose of the visit was to provide site specific assistance to the WWTP staff and correct deficiencies and less than optimum practices.

The Phase I on-site diagnostic evaluation of the WWTP was conducted during the period of April 25-29, 1994. Members of the Parsons Engineering Science (Parsons ES) Team included:

- Mike Hewitt - Parsons ES Project Manager
- Charles Baylot - Parsons ES Project Engineer

During the period of the Phase I visit, the Parsons ES team members evaluated the operation and maintenance of the treatment facility. This was accomplished through on-site observations, meetings and interviews with operators and other base personnel, and document and data review.

2.2 ACCOMPLISHMENTS OF PHASE I VISIT

During the Phase I visit, the team made a number of significant accomplishments. The major accomplishments include:

- Diagnostic evaluation of each unit treatment process.
- Evaluation of sampling, laboratory procedures and analytical equipment.
- Evaluation of preventive maintenance and safety programs.
- Evaluation of plant recordkeeping systems.
- Evaluation of operator job skills, training and promotion opportunities.
- Evaluation of management structure for the WWTP.
- Evaluation of the effect of non-domestic discharges on the WWTP.
- Inspection and evaluation of all remote lift stations.

2.3 PHASE I OBSERVATIONS AND RECOMMENDATIONS

Recommendations of needed improvements, modifications and changes in operating practices were included in the Phase I Diagnostic Report dated July 1994. A summary of these recommendations are presented in Table 2.1.

**Table 2.1. Shaw AFB Wastewater Treatment Plant
Specific Recommendations and Estimated Implementation Costs**

Recommendation	Comments/Significance	Estimated Cost of Implementation
1. A map of the sludge land application system should be developed including numbered plots which can be used to facilitate records of disposal.	To optimize even distribution of sludge and loading on the site.	None.
2. Improved records of sludge disposal should be kept.	Data on disposed sludge, site loading, and disposal locations should be maintained.	None.
3. The WWTP should improve daily operations records by developing forms for recordkeeping by plant personnel.	An operational log or daily check sheets should be used.	None.
4. Improvements should be initiated in personnel utilization.	Decrease field time through equipment upgrading at water booster stations and monitoring of lift stations.	Capital cost items. No estimate available at present.
5. The WWTP should develop a weekly safety equipment checklist.	Including all plant safety equipment.	None.
6. Implement technical training for military operators in wastewater treatment operations.	Use correspondence courses such as "Operation of Wastewater Treatment Plants" from Sacramento State University and in-house training.	Approximately \$100 per operator for the correspondence course.
7. Send senior O&M personnel to outside seminars once per year.	Two persons per year.	\$500-1000 per year depending on the location.
8. Develop a reference/training library at the WWTP.	Books can be obtained through the base library. Refer to list in Section 3 of this report.	\$250-300.
9. Hold weekly staff meetings at the WWTP.	To inform operators of operational strategies and trends and discuss problems/solutions.	None.

Table 2.1. (Continued) Shaw AFB Wastewater Treatment Plant
Specific Recommendations and Estimated Implementation Costs

Recommendation	Comments/Significance	Estimated Cost of Implementation
10. Initiate troubleshooting procedures at the grit removal system.	Determine reasons for lack of grit removal.	None.
11. Provide vendor training for the operation of the influent screw pumps variable speed drives.	Variable speed drive operation should be incorporated into the EQ basin operating strategy.	No cost to WWTP.
12. Install a viable lime feed system at the plant headworks to increase alkalinity for proper functioning of the activated sludge system.	System must be capable of feeding 275-300 pounds per day of lime.	Up to \$5,000 depending on availability of equipment, tankage piping, etc. in-house.
13. Implement a process control strategy for the activated sludge system based on maintaining a constant SRT.	Initial target SRT should be 22 days.	None.
14. Waste sludge from the activated sludge system daily.	Based on wasting calculations provided during Phase I.	None.
15. Obtain a D.O. meter with a 50-foot cable/probe for measurement of D.O. in the aeration basins.	Each basin's D.O. should be measured daily.	\$1500 for meter and probe.
16. Purchase a "sludge judge" for measuring sludge blanket depth in the secondary clarifiers.	Each clarifier should be monitored for blanket depth once/shift.	Less than \$100,00.
17. Purchase and install a flow meter for the WAS line.	WAS flow is a critical process control measurement.	Approximately \$5,000.
18. Replace all media in the tertiary filters.	Anthracite, sand and gravel.	Approximately \$1,000.
19. Repair or replace the out-of-service surface washing equipment on the tertiary filters.	Backwashing improvements.	Up to \$500.

Table 2.1. (Continued) Shaw AFB Wastewater Treatment Plant
Specific Recommendations and Estimated Implementation Costs

Recommendation	Comments/Significance	Estimated Cost of Implementation
20. Develop an operating strategy and maintain records of filter operation as outlined in Section 4.1.6.	Improve long term filter operation and backwashing effectiveness.	None.
21. Modify piping at the chlorine contact chambers to allow use of the new chamber during normal operations.	Unit can presently be used only during filter bypass.	Piping and construction costs are unknown at present.
22. Implement aerobic digester operating strategy as outlined in Section 4.1.8.	Control the process based on percent reduction in volatile matter.	None.
23. Increase maintenance priority on tank truck used to haul liquid sludge to land application site. Use contract hauling during extensive periods of truck down-time.	Maintain sludge removal capability to the greatest extent possible to ensure plant process operations are not adversely impacted.	None.
24. Conduct an industrial survey of all base maintenance shops and their waste hauling practices.	Identify all potential sources of problems to WWTP operations.	None. Unless survey is contracted out.
25. Perform a detailed follow-up inspection and analysis of records at the base Photo Shop to verify past disposal of penetrant line baths.	This shop has a strong potential impact on the WWTP.	None.
26. Replace or repair the skimmers on the secondary clarifiers.	A work order was written for this during the Phase I visit.	None.
27. The weirs on the secondary clarifier should be checked to ensure that they are level.	Requires a transit and may require assistance from CE squadron.	None.
28. Improve housekeeping in and repair doors on the digester blower room.	Closing doors will improve housekeeping in this area greatly.	\$200.
29. Document changes made to filter instrumentation and controls.	Circuit diagrams are needed.	In-house cost.

Table 2.1. (Continued) Shaw AFB Wastewater Treatment Plant
Specific Recommendations and Estimated Implementation Costs

Recommendation	Comments/Significance	Estimated Cost of Implementation
30. Implement minor procedural and recordkeeping changes for laboratory analyses discussed in Section 6.2.	BOD, TSS.	None.
31. Obtain laboratory certifications for all permitted parameters and use in-house analyses for reporting to DHEC.	Discontinue outside contract lab for certified parameters.	Initial cost savings of approximately \$5,000/year
32. Run solids tests on MLSS, RAS, WAS, secondary clarifier and filter effluent daily.	Necessary process control testing for plant operation.	None.
33. Improve organization of plant records.	WWTP operating logs, DMRs, permits.	None.
34. Develop a weekly safety inspection checklist.	Ensures safety equipment is available and working.	None.
35. Purchase additional safety equipment discussed in Section 8.2.	Fire extinguishers, safety shower, life rings.	Approximately \$1,000.
36. An emergency procedure is needed for responding to chlorine leaks.	Response, reporting, evacuation, etc.	None.
37. Procedures are needed for the WWTP SCBA equipment.	Cleaning, disinfection, storage.	None.

SECTION 3

ASSISTANCE PHASE SUMMARY

3.1 SUMMARY OF SITE VISITS

The major purpose of the Phase II site visits was to provide assistance and support in the implementation of the recommendations made in Phase I of the WWTP Environmental Study Project. During Phase II, the Operations and Maintenance Manual for the WWTP was drafted. A second major purpose of Phase II is to verify and validate the contents of the O&M Manual at the plant site. Four, 2-day, on-site visits were conducted at the Shaw AFB WWTP. The dates of these visits are as follows:

- 1 - July 11-12, 1994
- 2 - September 22-23, 1994
- 3 - October 24-25, 1994
- 4 - December 1-2, 1994

During each site visit, a careful review of the current status of each of the recommendations from Phase I was made. Assistance was provided in implementing the recommendation where possible, and the progress made was documented in Letter Reports 3, 4, 5 and 6.

3.2 STATUS OF PROJECT RECOMMENDATIONS IN PHASE II

The status of all project recommendations from Phase I and Phase II were summarized at the conclusion of the Phase II visits. Those recommendations and their status at the conclusion of the assistance phase are included here in Table 3.1.

**Table 3.1. Shaw AFB Wastewater Treatment Plant
Specific Recommendations and Status as of 12/2/94**

Recommendation	Comments/Significance	Current Status
1. A map of the sludge land application system should be developed including numbered plots which can be used to facilitate records of disposal.	To optimize even distribution of sludge and loading on the site.	Records are needed which comply with 40 CFR Part 503 Biosolids Rule. Refer to Appendix A of this report for a summary of required records.
2. Improved records of sludge disposal should be kept.	Data on disposed sludge, site loading, and disposal locations should be maintained.	Currently, a sludge report is in use at the WWTP which includes records of sludge drawn to the drying beds, sludge wasted to the digesters, supernatant drawn from the digesters and liquid sludge hauled to the land application site.
3. The WWTP should improve daily operations records by developing forms for recordkeeping by plant personnel.	An operational log or daily check sheets should be used.	Daily operations comprehensive logs and process checklists have been fully implemented.
4. Improvements should be initiated in personnel utilization.	Decrease field time through equipment upgrading at water booster stations and monitoring of lift stations.	Equipment has been installed for remote monitoring of the lift stations to improve personnel utilization. Hardware is in place and a computer terminal has been installed at the plant as a remote monitoring station. Efforts have been completed to combine shops with the Outside Plumbing Shop to improve personnel utilization efficiency. Equipment for monitoring the wells and water tanks has not been installed as yet.

Table 3.1. (Continued) Shaw AFB Wastewater Treatment Plant
Specific Recommendations and Status as of 12/2/94

Recommendation	Comments/Significance	Current Status
5. The WWTP should develop a weekly safety equipment checklist.	Including all plant safety equipment.	A monthly safety inspection checklist has been developed by plant staff and is in use.
6. Implement technical training for military operators in wastewater treatment operations.	Use correspondence courses such as "Operation of Wastewater Treatment Plants" from Sacramento State University and in-house training.	Shaw AFB intends to implement this training item over the next several months.
7. Send senior O&M personnel to outside seminars once per year.	Two persons per year.	This item will be implemented.
8. Develop a reference/training library at the WWTP.	Books can be obtained through the base library. Refer to list in Section 3 of this report.	The WWTP will investigate using the base library to develop an in-house technical library.
9. Hold weekly staff meetings at the WWTP.	To inform operators of operational strategies and trends and discuss problems/solutions.	Weekly staff meetings are being held and are now being used as a forum for process control strategy and implementation.
10. Initiate troubleshooting procedures at the grit removal system.	Determine reasons for lack of grit removal.	The grit removal system requires modification by the construction contractor to reinstall the rakes correctly.
11. Provide vendor training for the operation of the influent screw pumps variable speed drives.	Variable speed drive operation should be incorporated into the EQ basin operating strategy.	The vendor is scheduled to visit the plant to install a new panel and plant staff plan to discuss further with him the operation of the variable speed drive units.
12. Install a viable lime feed system at the plant headworks to increase alkalinity for proper functioning of the activated sludge system.	System must be capable of feeding 275-300 pounds per day of lime.	Currently the plant is utilizing the lime feed system at the screw pump structure. The lime feeder at the RAS Parshall Plume does not have sufficient capacity. A new system is under design currently.

Table 3.1. (Continued) Shaw AFB Wastewater Treatment Plant
Specific Recommendations and Status as of 12/2/94

Recommendation	Comments/Significance	Current Status
13. Implement a process control strategy for the activated sludge system based on maintaining a constant SRT.	Initial target SRT should be 22 days.	The SRT process strategy has been fully implemented. The lab is producing the data needed to waste the proper amount of activated sludge and that volume is being wasted. A computer spreadsheet was set up during the second Phase II visit for entry of process data and calculation of SRT and wasting rates.
14. Waste sludge from the activated sludge system daily.	Based on wasting calculations provided during Phase I.	Daily wasting of activated sludge is being done.
15. Obtain a D.O. meter with a 50-foot cable/probe for measurement of D.O. in the aeration basins.	Each basin's D.O. should be measured daily.	A new D.O. meter and cord is now in operation at the WWTP.
16. Purchase a "sludge judge" for measuring sludge blanket depth in the secondary clarifiers.	Each clarifier should be monitored for blanket depth once/shift.	A sludge judge is now in use at the secondary clarifiers.
17. Purchase and install a flow meter for the WAS line.	WAS flow is a critical process control measurement.	The new sludge pump has been installed. The flow meter for the WAS line was delivered.
18. Replace all media in the tertiary filters.	Anthracite, sand and gravel.	New filter media has been delivered.
19. Repair or replace the out-of-service surface washing equipment on the tertiary filters.	Backwashing improvements.	Repair or replacement of filter surface washing equipment has not been completed.
20. Develop an operating strategy and maintain records of filter operation as outlined in Section 4.1.6.	Improve long term filter operation and backwashing effectiveness.	A recordkeeping form for filter operation has been developed and is in use.

Table 3.1. (Continued) Shaw AFB Wastewater Treatment Plant
Specific Recommendations and Status as of 12/2/94

Recommendation	Comments/Significance	Current Status
21. Modify piping at the chlorine contact chambers to allow use of the new chamber during normal operations.	Unit can presently be used only during filter bypass.	Implementation of this recommendation has been initiated. A design project is underway but funding is uncertain.
22. Implement aerobic digester operating strategy as outlined in Section 4.1.8.	Control the process based on percent reduction in volatile matter.	This has been implemented. The decanting weir boxes in all three Digesters have been modified and supernatant is being drawn daily.
23. Increase maintenance priority on tank truck used to haul liquid sludge to land application site. Use contract hauling during extensive periods of truck down-time.	Maintain sludge removal capability to the greatest extent possible to ensure plant process operations are not adversely impacted.	All sludge hauling is currently being performed by a contract firm.
24. Conduct an industrial survey of all base maintenance shops and their waste hauling practices.	Identify all potential sources of problems to WWTP operations.	A survey of industrial shops by Bioenvironmental Engineering is underway.
25. Perform a detailed follow-up inspection and analysis of records at the base Photo Shop to verify past disposal of penetrant line baths.	This shop has a strong potential impact on the WWTP.	See comment in No. 24 above.
26. Replace or repair the skimmers on the secondary clarifiers.	A work order was written for this during the Phase I visit.	This item has been completed.
27. The weirs on the secondary clarifier should be checked to ensure that they are level.	Requires a transit and may require assistance from CE squadron.	This item has not been initiated as yet. A request has been made by the Base to replace the clarifier internals.
28. Improve housekeeping in and repair doors on the digester blower room.	Closing doors will improve housekeeping in this area greatly.	This item has been completed.

Table 3.1. (Continued) Shaw AFB Wastewater Treatment Plant
Specific Recommendations and Status as of 12/2/94

Recommendation	Comments/Significance	Current Status
29. Document changes made to filter instrumentation and controls.	Circuit diagrams are needed.	This item has not been initiated as yet. Renovation of the filter control system is being considered.
30. Implement minor procedural and recordkeeping changes for laboratory analyses discussed in Section 6.2.	BOD, TSS.	BOD and TSS are now being run by the outside contract lab for purposes of NPDES Permit reporting and compliance.
31. Obtain laboratory certifications for all permitted parameters and use in-house analyses for reporting to DHEC.	Discontinue outside contract lab for certified parameters.	It has been decided by WWTP management not to pursue additional certification for the laboratory.
32. Run solids tests on MLSS, RAS, WAS, secondary clarifier and filter effluent daily.	Necessary process control testing for plant operation.	Implemented.
33. Improve organization of plant records.	WWTP operating logs, DMRs, permits.	Improvement in the organization of plant records has been noted.
34. Purchase additional safety equipment discussed in Section 8.2.	Fire extinguishers, safety shower, life rings.	The purchase of additional safety equipment has been completed.
35. An emergency procedure is needed for responding to chlorine leaks.	Response, reporting, evacuation, etc.	The emergency spill response procedures have been modified to include a procedure for responding to chlorine or sulfur dioxide leaks.
36. Procedures are needed for the WWTP SCBA equipment.	Cleaning, disinfection, storage.	Procedures for storage, cleaning and disinfection of the SCBA equipment have been developed and are kept with each SCBA unit, and in a safety notebook.

SECTION 4

VERIFICATION PHASE

4.1 VERIFICATION PHASE

4.1.1 Introduction

The Phase III site visit was conducted by Mike Hewitt, ES Project Manager, from January 18-20, 1995. The purpose of the visit was to assess improvements in operation of the WWTP since the initiation of the WWTP Environmental Study Program. The reassessment involved a follow-up evaluation of the individual unit processes, the overall operation of the treatment plant and other areas such as laboratory, preventive maintenance and safety.

As discussed in Section 1 of this report, meetings were held with operators and other key base personnel throughout the Phase III visit. These meetings covered a variety of topics including the status of all improvements made relative to the recommendations made during Phase I.

During the Phase III visit, all applicable operating data was collected for the previous twelve months for evaluation. Operating logs were examined and visual observations of plant processes and activities were conducted.

4.2 OBSERVATION AND CURRENT STATUS

4.2.1 General

The operation of the Shaw AFB WWTP has improved considerably over the past nine months. Implementation of project recommendations such as development of the sludge retention time (SRT) process control strategy, modification of digester operations and initiation of solids management practices has greatly increased the consistency and reliability of plant performance. Other initiatives and efforts by plant staff, plant management and 20 CES personnel have also contributed to improvements. Of the total of thirty-six recommendations made, twenty-two were totally completed by the conclusion of the Phase III visit. In addition, another 8 were either partially completed or in progress. This level of completion represents a substantial effort on the part of plant personnel and is very commendable. The effort has paid off in plant performance improvements. In the twelve months prior to the WWTP Environmental Study at Shaw AFB, the plant had thirty-one instances in which the discharge exceeded limits of the facility's NPDES permit. In the nine months since the project was initiated and efforts have been underway to make improvements, there have been a total of five instances of the discharge exceeding NPDES limitations. This represents an eighty-four percent

reduction in permit violations to date. The five violations which have occurred have been for either fecal coliform bacterial limits or total residual chlorine limits.

One of the problems that has occurred in recent months has been the inability of the plant to produce a sufficient chlorine residual in the chlorine contact chamber to adequately disinfect the effluent. During two instances, plant personnel attempted to increase the chlorine residual by increasing the chlorine feed but were unable to do so. All the feed systems and chlorine solution lines were checked thoroughly and found to be intact. This problem occurs seasonally in nitrifying activated sludge plants due to incomplete nitrification. Incomplete nitrification produces higher than normal concentrations of nitrites in the effluent. Nitrite, being a reducing agent, creates a high chlorine demand and resultant difficulty in attaining adequate chlorine residual and fecal coliform bacteria kill. This problem requires some fine tuning of the SRT control method. It was recommended to plant staff to increase the SRT from its original target of 22 days to 27 days.

4.2.2 Plant Staffing and Management

Since the initiation of the project there has been a turnover in the NCOIC for the WWTP. Senior Master Sergeant Peter Navin was assigned to Shaw AFB shortly after the Phase I on-site evaluation was conducted. As the senior staff member at the WWTP, SMSgt. Navin provided impetus and momentum toward the implementation and completion of most of the project recommendations. His leadership greatly facilitated many of the improvements made at the plant.

Another important change which occurred during the project was the installation and hook up of a telemetry system to alert personnel at the plant of alarm conditions at the wastewater lift stations. This has improved personnel utilization from the standpoint of reduced manhours on routine lift station visits. The stations only need to be physically visited when necessary to provide preventative maintenance. The water booster stations also need to be set up with alarm condition sensors tied to the terminal at the plant.

4.2.3 Plant Operation/Process Control

Plant personnel have implemented the recommended process control strategy for the activated sludge process at the plant. Daily tests and calculations are being used for wasting sludge to maintain a constant sludge retention time (SRT). During the second Phase II site visit, a computer spreadsheet was developed for entry of process data and automatic calculation of SRT and sludge wasting rates. This spreadsheet facilitates data calculation and manipulation on a daily basis. Once plant personnel become more proficient in the use of the spreadsheet software, data and trends can be analyzed to further fine-tune the treatment system. Trend analysis can also be useful as a predictive tool for avoidance of process problems.

A new sludge pump and flow meter for the waste activated sludge line have been installed at the plant. The new pump has improved sludge wasting efficiency. The new

meter significantly improved the accuracy of process calculations and the fine-tuning of process operations.

New gravel, sand, and anthracite media for the tertiary filter has been installed. These items greatly improve the overall filter performance. The filter surface washers have been repaired and returned to service also.

The operation of the aerobic digesters has been improved significantly. All three decanting weir boxes were modified, which allows the operators to correctly withdraw supernatant, which, in turn, provides needed volume in the digesters for daily wasting from the activated sludge system. The daily decanting and resultant thickening of the digester sludge have improved the efficiency of the digester operation and improved the solids inventory condition of the plant as a whole.

The WWTP is utilizing the services of a contractor for hauling sludge to the land application site. This has improved the efficiency of sludge removal from the lime stabilization system and in combination with the items discussed above regarding digester operation, the plant maintains no current solids back log.

4.2.4 Plant Performance

Twelve months of data were compiled during the Phase III visit. The data indicates that during the nine months since the beginning of the program, there were five instances where the plant exceeded the NPDES Permit limits. Four of these excursions were for the maximum fecal coliform limit and one was for the total residual chlorine limit. In the twelve months prior to the study and the implementation of project recommendations, there were thirty-one permit violations including violations of the effluent BOD and total suspended solids (TSS) limitations. This represents an eighty-four percent reduction in permit violations. Figures 4.1 through 4.10 illustrate the monthly average and monthly maximum values plotted against the respective permit limits for flow BOD, TSS, ammonia nitrogen, dissolved oxygen, total residual chlorine and fecal coliform bacteria for the period April - December 1994.

4.2.5 Plant Maintenance

The plant maintenance program is essentially the same as it was in April 1994. The plant utilizes the base-wide Recurring Work Program (RWP). The RWP system generates weekly list of items requiring maintenance on the Recurring Work Program Report (RWPP). Once completed, these items are entered into the system for permanent recordkeeping. Items not completed appear on subsequent RWPPs as outstanding. Each item scheduled is generated from a master file which is cross referenced to Maintenance Action Sheets (MAS). The MAS provide details of maintenance tasks to be performed from the RWPP.

The plant has a computerized list of spare parts which indicates the part name, bin number where the part is located, the part number and the quantity on hand. The plant has a complete list of manufacturers' manuals and a set of drawings for the plant is

FIGURE 4.1

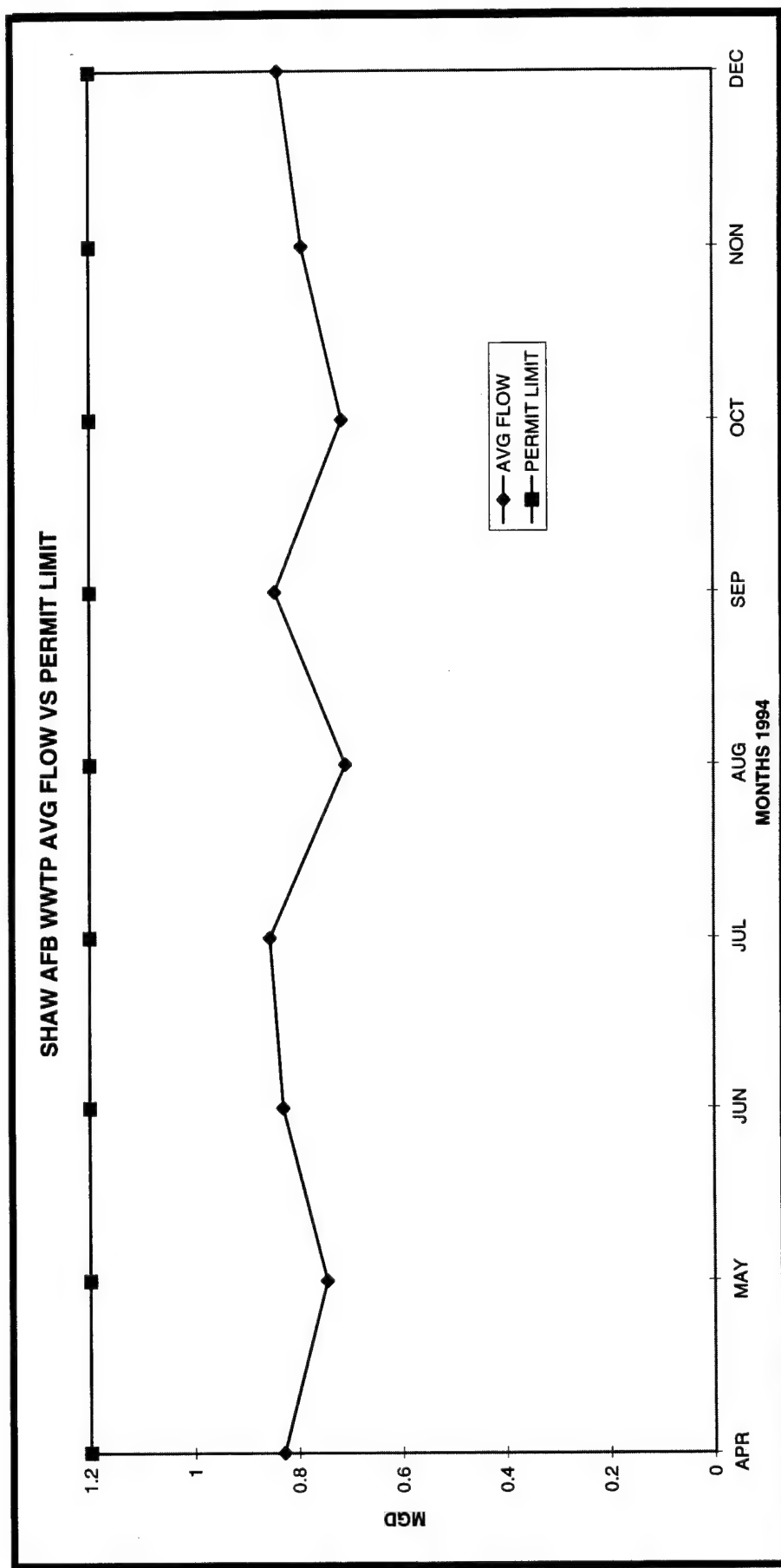


FIGURE 4.2

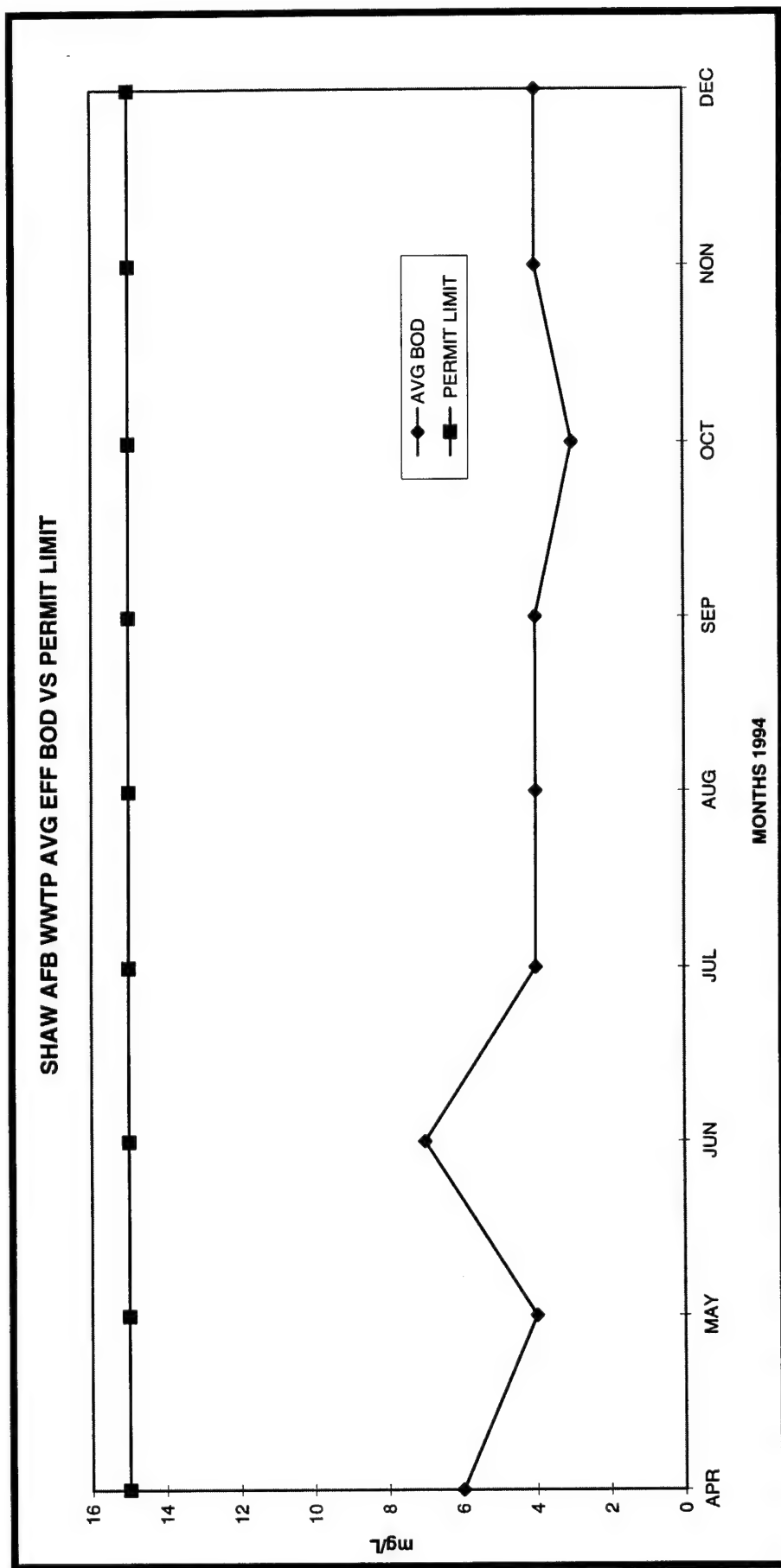


FIGURE 4.3

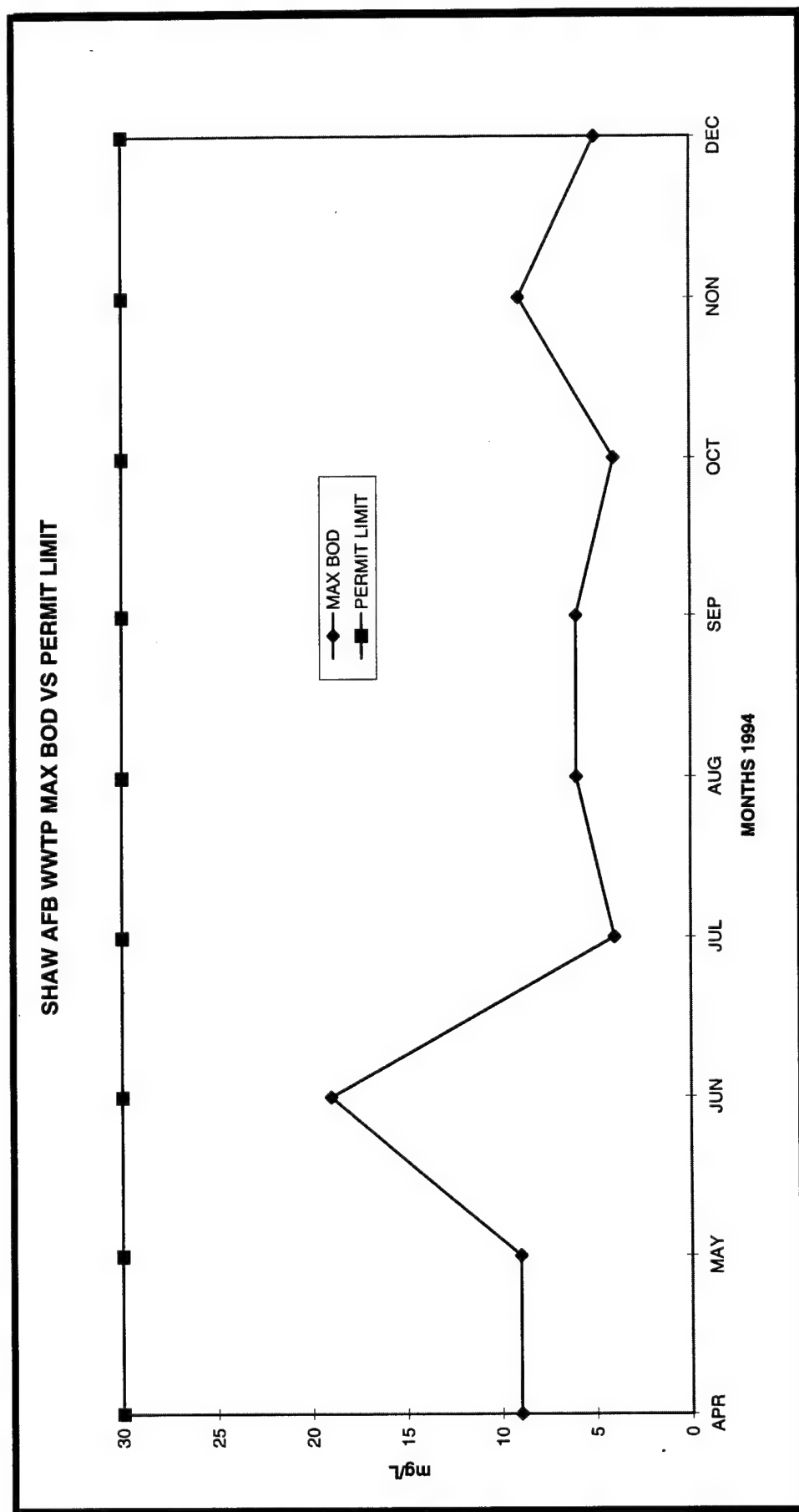


FIGURE 4.4

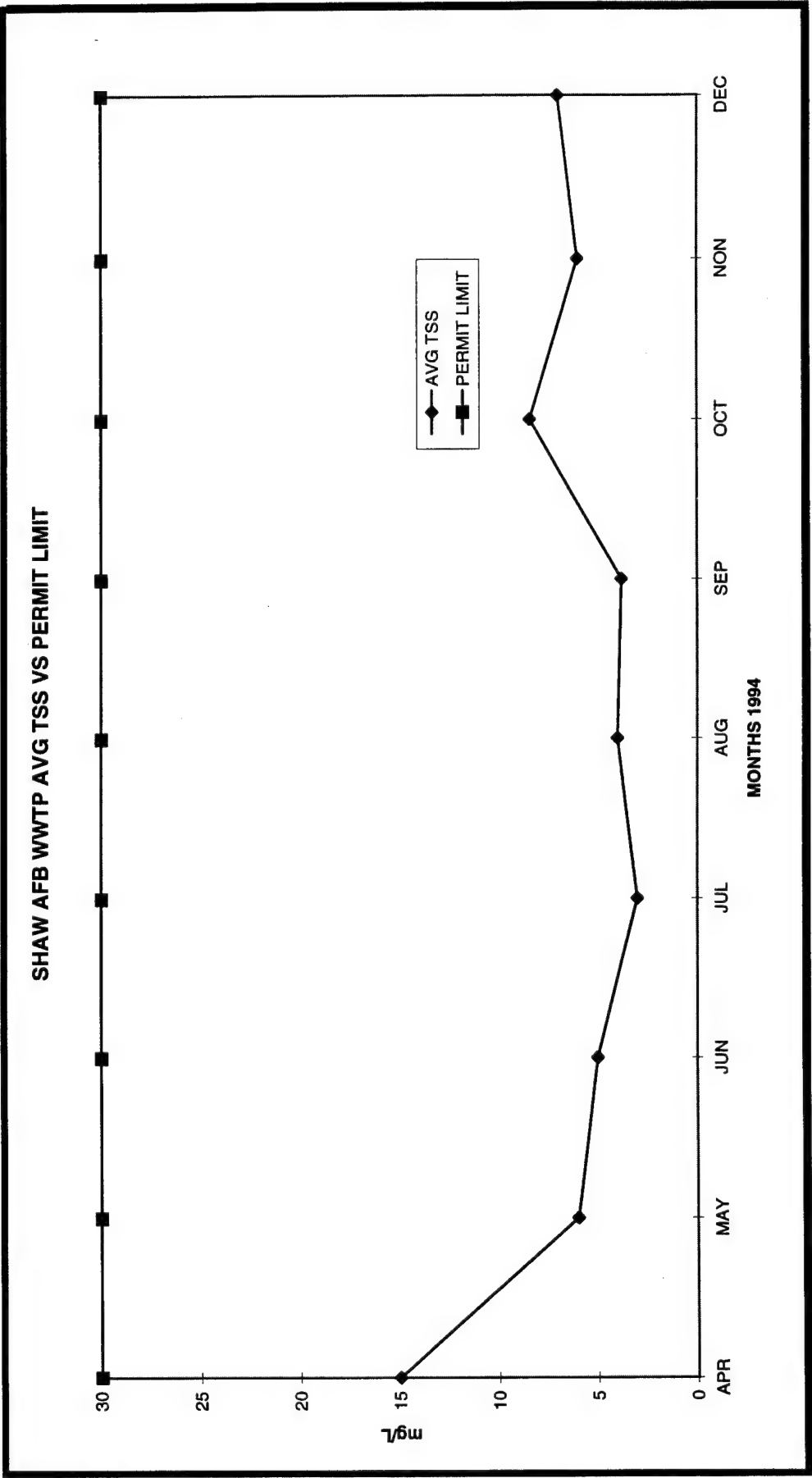


FIGURE 4.5

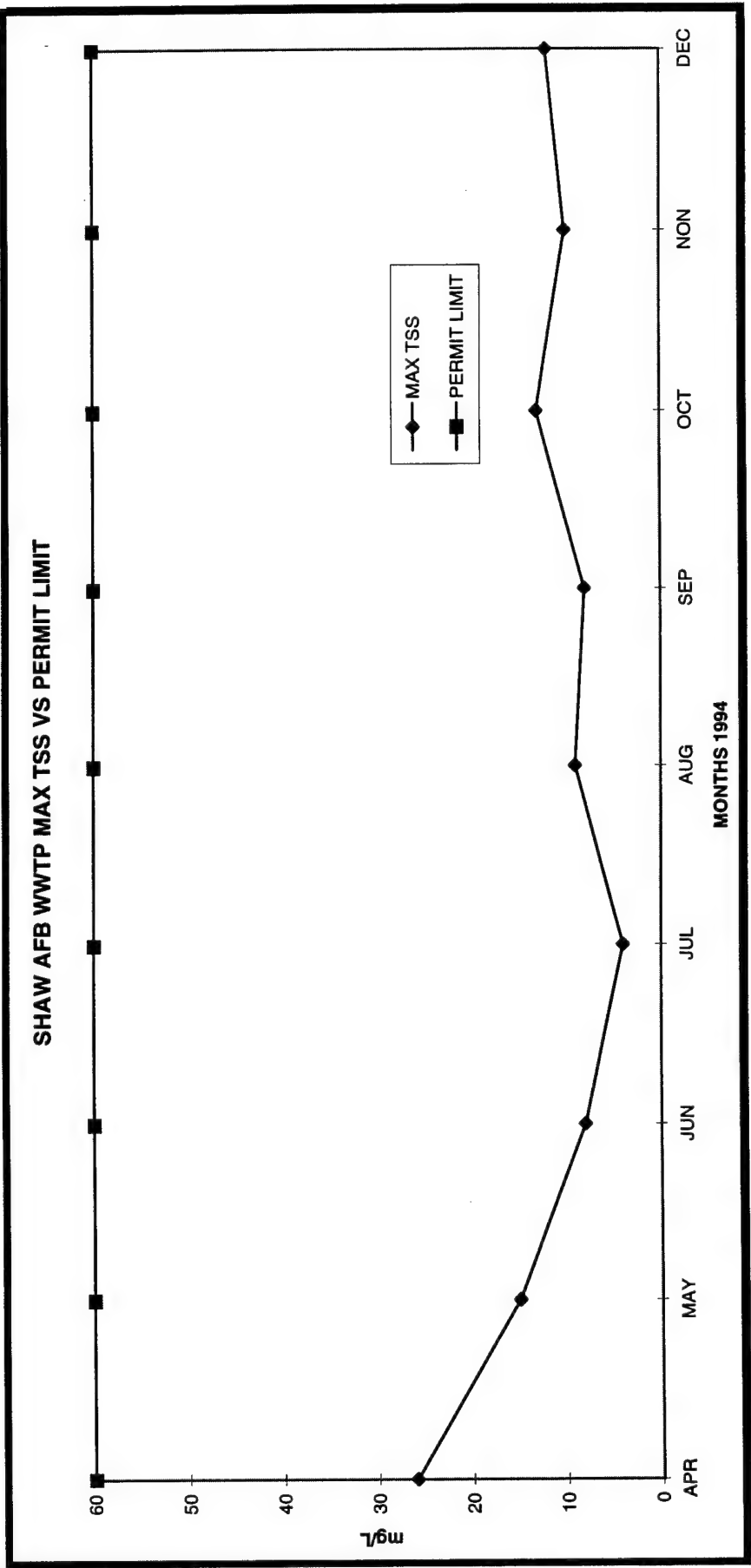


FIGURE 4.6

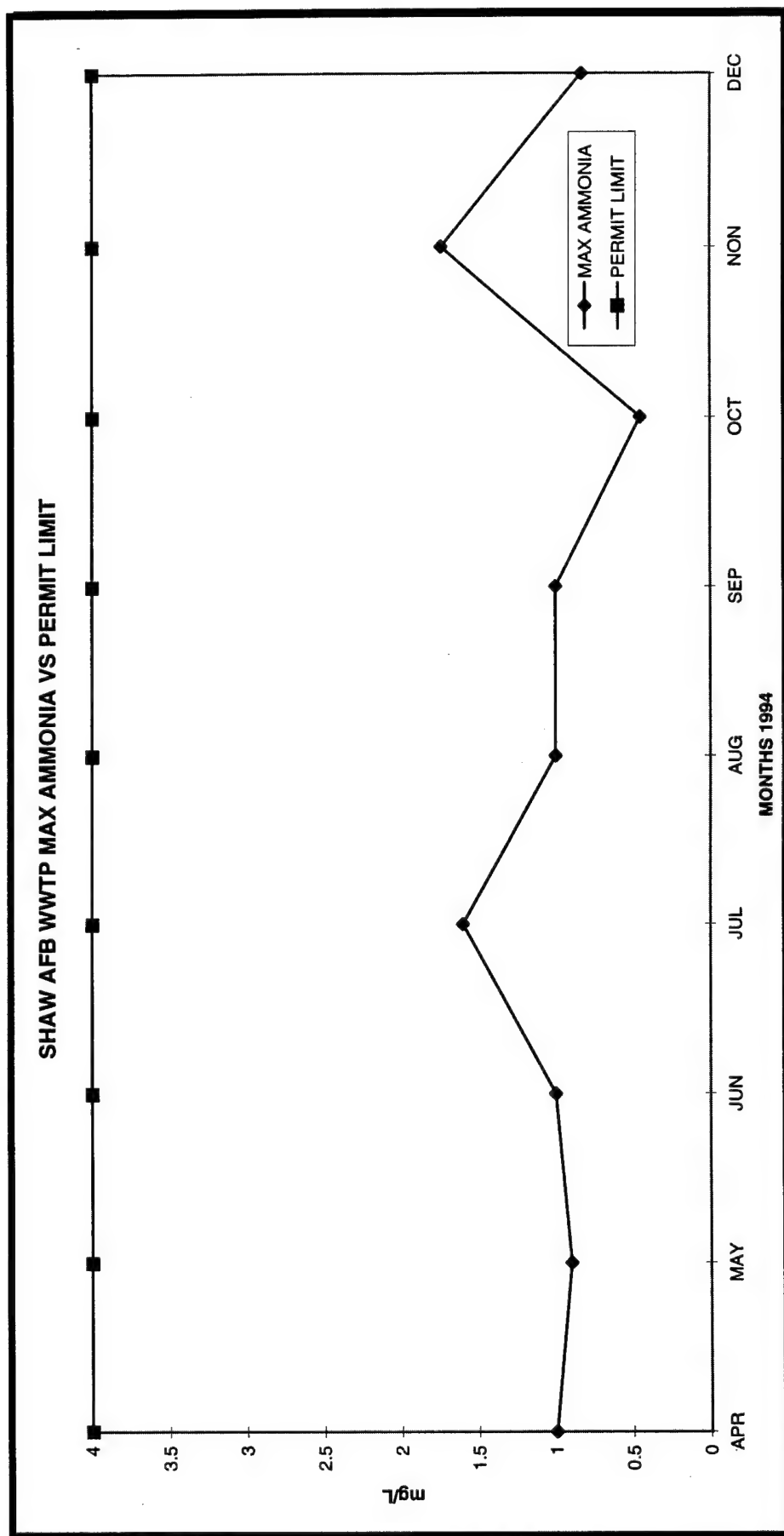


FIGURE 4.7

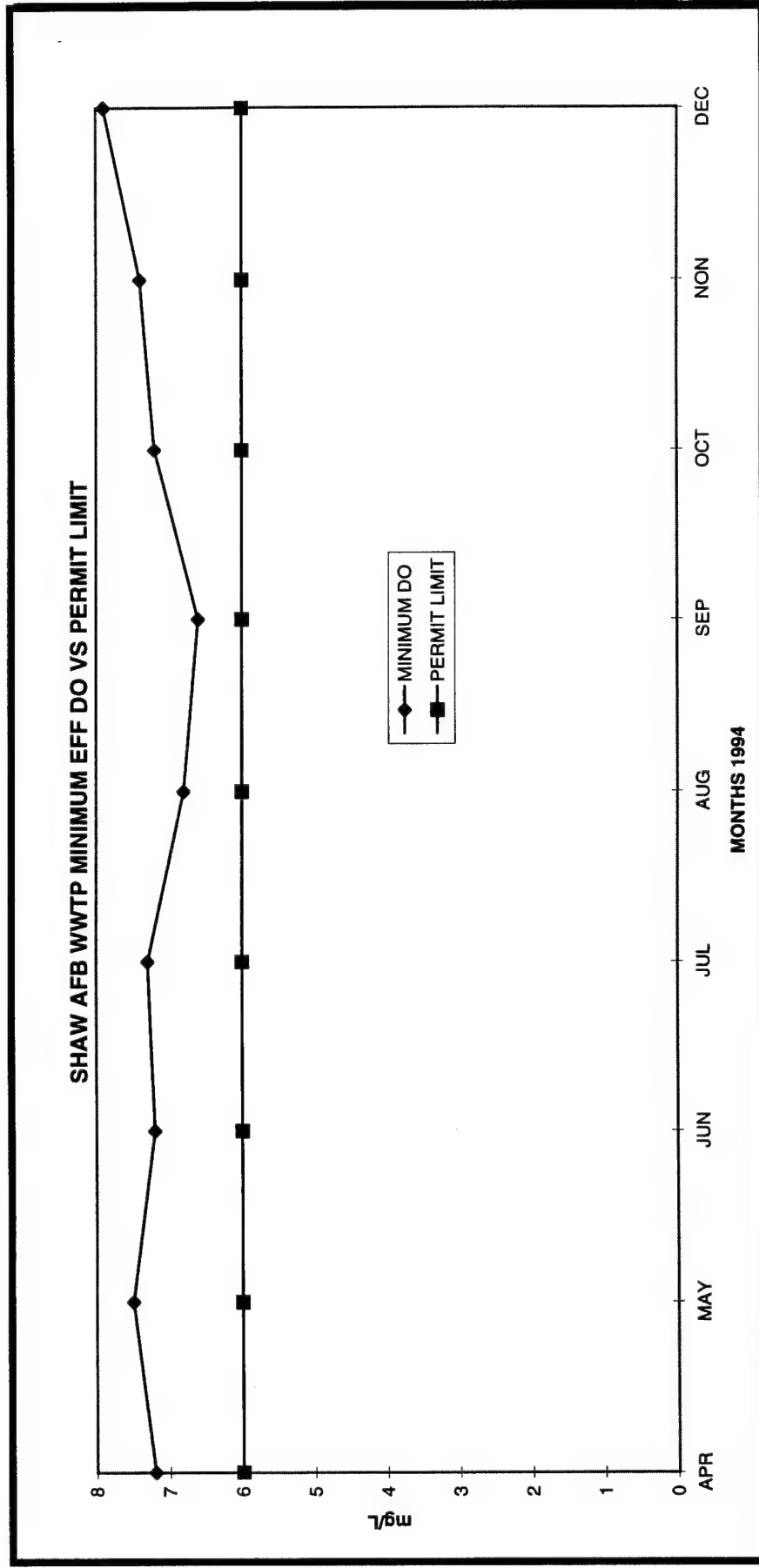


FIGURE 4.8

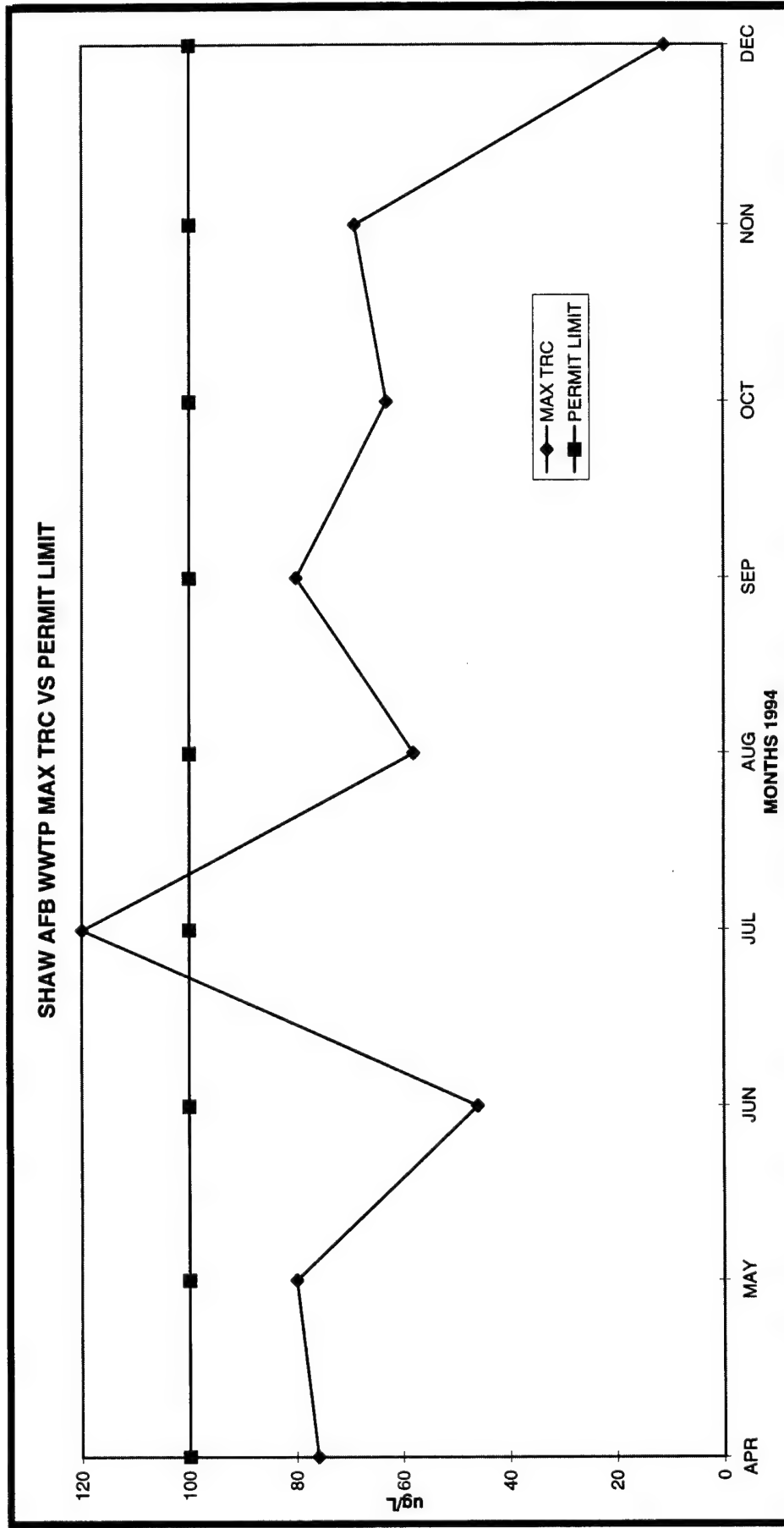


FIGURE 4.9

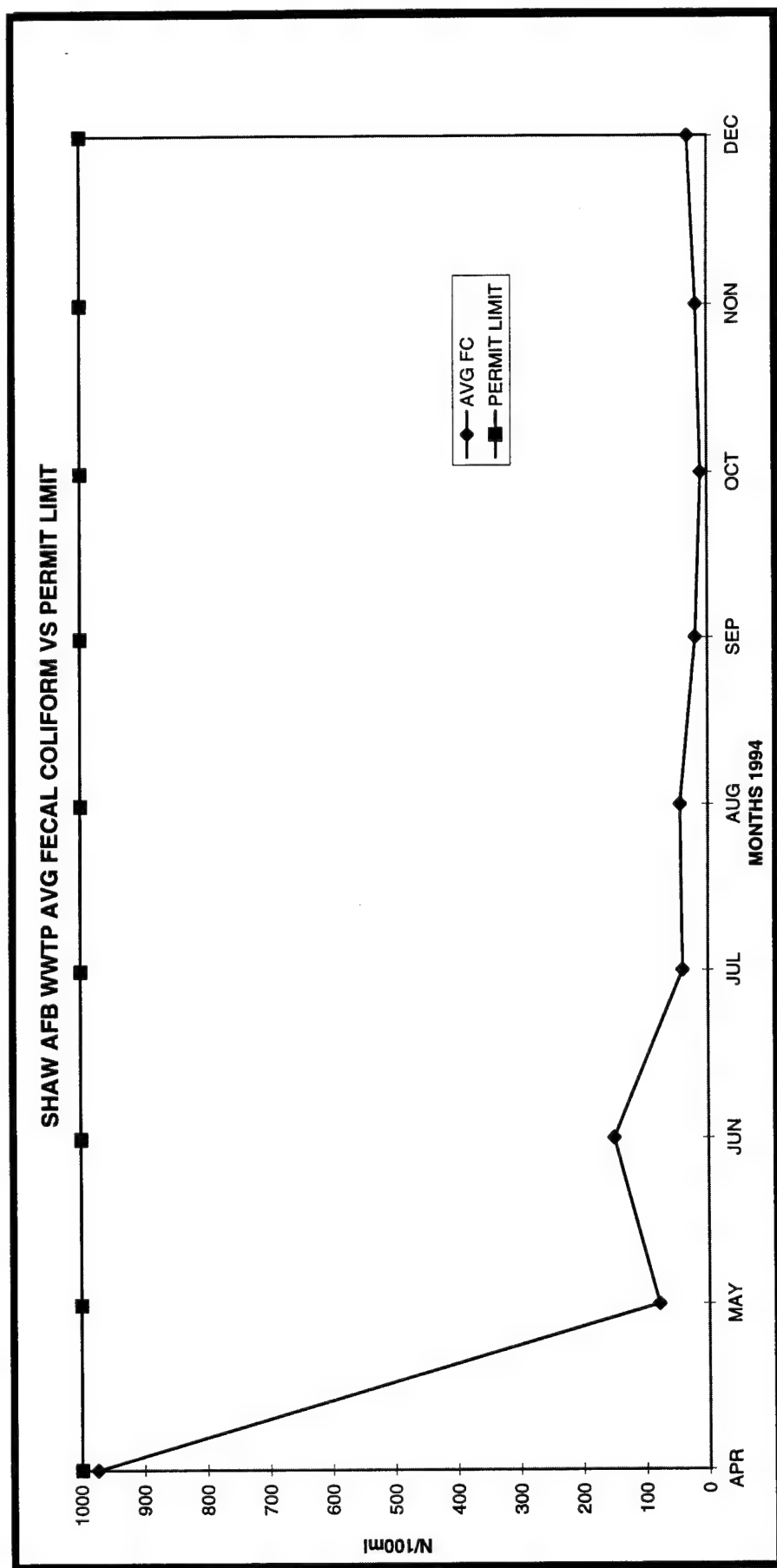
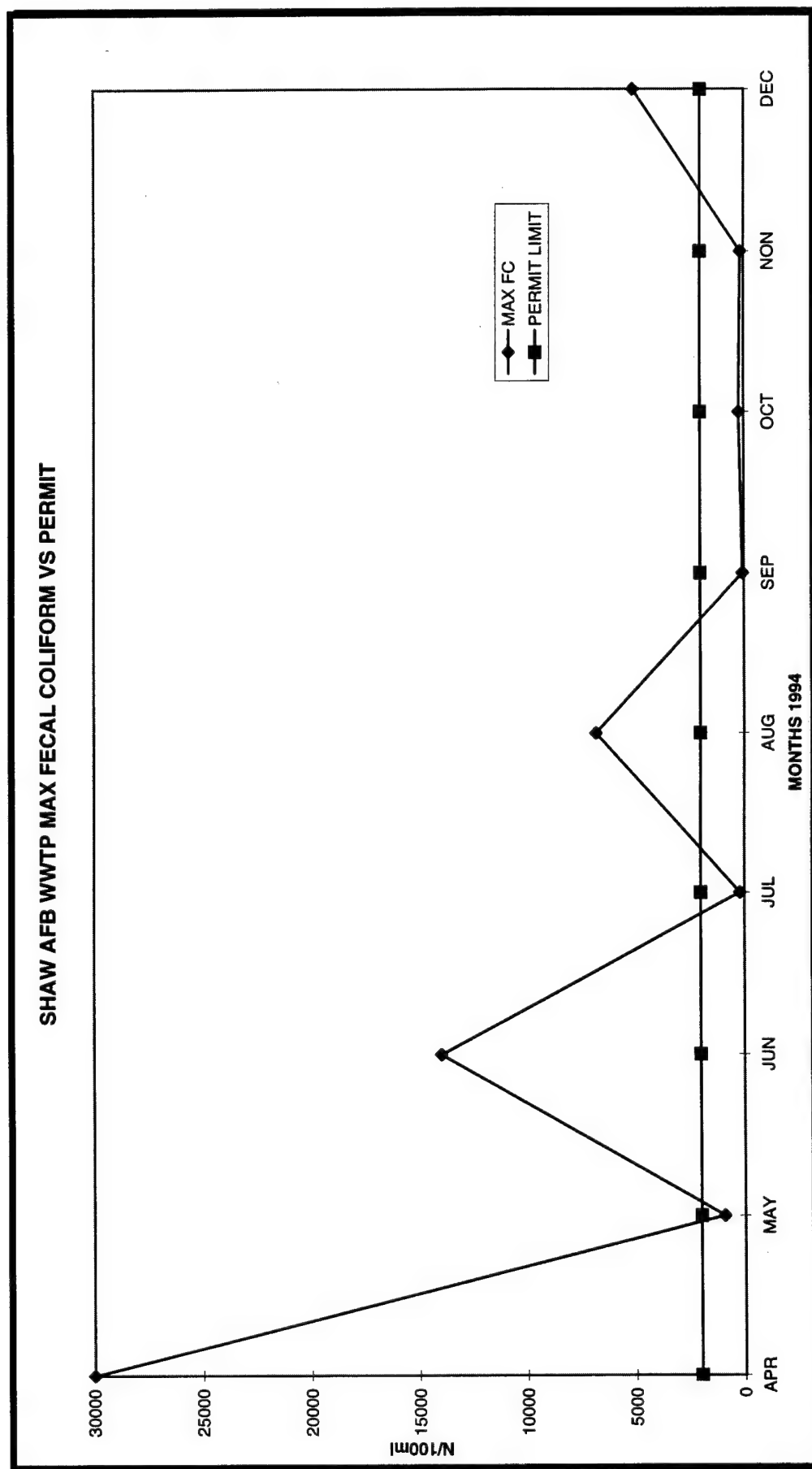


FIGURE 4.10



available at the plant site. The manufacturers' manuals were utilized by the project team to develop a preventive maintenance schedule for the new plant equipment. This information is included in the O&M manual developed during the WWTP Environmental Study.

In addition, numerous improvements were made to plant equipment that were either not functioning or improperly functioning during the first phase of the project. The following is a status update on the major equipment problems noted during Phase I:

- The variable speed drives for the influent pump station were not functional during Phase I of the project. These units were apparently not intended to function as variable speed units. Flow control using the influent gates will continue as the preferred operational strategy.
- The skimmers on the secondary clarifiers have been repaired.
- The weirs on the secondary clarifiers will be checked for level and adjusted during the next major upgrade work on these units.
- The surface washers in the tertiary filters have been repaired.
- Housekeeping in the digester blower room has been improved.
- The secondary clarifier launders were painted during Phase II of the project.
- The media in both the tertiary filters has been replaced.
- The instrumentation controlling the operation of the tertiary filters needs to be documented. Drawings, similar to piping and instrumentation drawings should be prepared which indicate how the equipment is controlled.
- Problems with breakdown and the need for constant maintenance of the sludge handling truck have been resolved through use of a contractor for hauling sludge to the land application site.

4.2.6 Laboratory Analyses and Sampling

During the initial evaluation of the laboratory procedures and sampling, some of the required permit parameters were being analyzed by an outside contract laboratory for reporting purposes. In addition, the Shaw AFB WWTP laboratory was analyzing samples for Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), Dissolved Oxygen (DO), Total Residual Chlorine, and pH. At the time, the WWTP lab was certified by the South Carolina Department of Health and Environmental Control (DHEC) for these parameters. The remainder, including effluent ammonia and fecal coliform bacteria were being analyzed by the contract laboratory. At the time, it was the opinion of the evaluation team that there was an unnecessary duplication of effort and the recommendation was made that all permit required analyses be done in-house and the needed certifications be obtained. Shaw AFB decided not to pursue this recommendation but to instead use the services of the contract laboratory to satisfy all DEHC analytical requirements. At present, the WWTP has retained certification for those parameters that are required to be analyzed immediately after sampling such as pH, TRC and D.O. As

such there are no specific comments or recommendations in this area because these test procedures adhered to all requirements.

4.2.6.1 Process Control Testing

Several improvements have been made in the area of process control testing. A new analytical balance was procured for the WWTP laboratory and is housed on a new marble top table. Solids tests are being performed on the return sludge and secondary clarifier effluent five days per week in accordance with the requirements for the SRT process control strategy being utilized by the plant. A D.O. meter with field probe is being utilized for taking D.O. readings of the aeration basins. A sludge blanket finder (sludge sludge) is being utilized. During the fine tuning of the SRT process strategy, it became apparent that the WWTP also needed to have the capability to analyze for ammonia nitrogen, nitrates and nitrites.

One problem that has occurred in recent months has been the inability of the plant to produce a sufficient chlorine residual in the chlorine contact chamber to adequately disinfect the effluent. During two instances, plant personnel attempted to increase the chlorine residual by increasing the chlorine feed but were unable to do so. All the feed systems and chlorine solution lines were checked thoroughly and found to be intact. This problem occurs seasonally in nitrifying activated sludge plants due to incomplete nitrification. Incomplete nitrification produces higher than normal concentrations of nitrites in the effluent. Nitrite, being a reducing agent, creates a high chlorine demand and resultant difficulty in attaining adequate chlorine residual and fecal coliform bacteria kill. This problem requires some fine tuning of the SRT control method. It was recommended to plant staff to increase the SRT from its original target of 22 days to 27 days. In addition the WWTP should initiate process testing and tracking of nitrates, nitrites and ammonia in the effluent and use the data as a predictive tool in diagnosing the onset of incomplete nitrification. Along with the nitrate, nitrite and ammonia data, chlorine dosage and demand concentrations are being tracked. These parameters have already been added to the plant's process control spreadsheet.

4.2.7 Recordkeeping

The main issues related to recordkeeping at Shaw AFB that needed to be resolved were the need for improved organization of records, the need for additional process control/daily operating data and the need for safety inspection records. All these issues were resolved during the project. Organization of logs, monthly reports and permit related paperwork was greatly improved. All items requested were readily available in organized files. Plant personnel undertook the development of forms for recording and maintaining process control data. In addition, data is entered into an electronic spreadsheet and key process parameters such as SRT and target sludge wasting volumes are calculated daily. Overall, this is a very strong area of plant operation now and plant personnel should be commended. Plant personnel also developed a monthly safety inspection checklist.

The EPA Part 503 Biosolids Rule, which is the federal regulation governing land application of sludge, has specific recordkeeping requirements that apply to sludge land application activities at Shaw AFB. These requirements are in addition to those contained in your WWTP permit. The 503 Rule is intended to be a self-implementing requirement and is applicable even though DEHC has not been delegated this program yet from EPA or issued a land application permit to Shaw AFB. Appendix A of this report provides a summary of the recordkeeping requirements of the 503 Rule. Generally, the rule requires that records be kept of the ten required pollutants (arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium and zinc) and that a certification statement be prepared and signed for vector attraction, pathogen reduction and/or management practices, depending on the specific solids disposal option that the base has chosen. Federal agencies are required to keep these records but are not required to report them. The contact person at DEHC on specific questions related to the 503 Rule is Mr. Griff Cox at (803) 734-5318.

4.2.8 Safety

All the recommendations made with regard to improvements in the plant safety program have been made or are in progress. New procedures, equipment and records were developed during the project. The issue of a safety shower/eyewash unit at the operators' building is still in progress. The plan to move the chlorination system to an area near the tertiary filters negates the need for the shower/eyewash unit at the operator building.

4.2.9 Industrial Waste Control

The base has plans to conduct a thorough, systematic industrial waste survey to be conducted by an outside contractor in the near future.

SECTION 5

PROGRAM SUMMARY

5.1 PROGRAM SUMMARY

5.1.1 Summary of OMTAP Goals and Accomplishments

The objective of the WWTP Environmental Study program at Shaw AFB was to assist the installation in improving and optimizing the performance of the WWTP. The prime objective was to help ensure compliance with the NPDES Permit at the lowest practical cost. This task involved a diagnostic evaluation of the WWTP as a whole and of individual treatment units, review of operator and management structure, laboratory and sampling operations, record keeping, maintenance practices, safety and all related functions. Subsequent activities included follow-up implementation and support for recommendations made, production of an O&M manual to guide future operations, and verification of plant performance changes generated by the program.

In each phase of the program the Parsons ES WWTP Environmental Study team made every effort to bring to management's attention the problems which were encountered that were affecting plant performance and to provide definitive, cost-effective recommendations on how to correct them. Management involvement is critical to the success of this type of evaluation and corrective action program.

5.2 BENEFITS OF THE WWTP ENVIRONMENTAL STUDY PROGRAM

There are many benefits associated with the WWTP Environmental Study program at Shaw AFB. Many of the recommendations have cost little or nothing to implement at the WWTP. Other recommendations, when fully implemented, will result in cost avoidance or reallocation of resources for more efficient operation. Among the major benefits attributable to the program include:

- The increased process control analyses have allowed the operators to gain additional knowledge to base process decisions upon.
- The establishment of a process control strategy and the improved control of the activated sludge process have given key members of the plant staff a renewed confidence in their inability to properly operate the plant. This has improved staff morale at the WWTP.

- The increased involvement of management personnel in plant operation decisions has improved knowledge of plant operational issues and facilitated improved oversight and management of the facility.
- Recommendations made for additional or enhanced process or monitoring equipment to improve WWTP operations were implemented improving plant operability. Examples include the modified digester decanting weirs, the new waste sludge pump and waste sludge flow meter.
- WWTP NPDES permit excursions decreased by 85% when the twelve months prior to the study are compared with the nine months after the program was initiated.

5.3 LESSONS LEARNED

In any project similar in scope to the WWTP Environmental Study, a number of lessons will be learned. These can serve as tools to ensure future projects are even more effective and serve to point out to management areas of particular attention after the program ends. The lessons learned during the Shaw AFB project include the following:

- The timely receipt of documents by the evaluation team is an essential element in the project's success. This allows the OMTAP Team to be familiar as possible with the plant and plant problems prior to the initial visit to the facility.
- The need for involvement and communication with all operators is essential to the success of the program. This is especially true with regard to the written reports and the draft O&M Manual prepared by the team. The recommendations and desired results from all changes must be fully understood by all personnel.
- The procurement of additional laboratory equipment for process testing that is recommended should be initiated as early as possible in the program. This allows time for the team to assist the operators in getting the new procedures implemented during the subsequent visits.
- The time period following a plant upgrade design is an excellent time to undertake a WWTP Environmental Study. The meshing together of engineering design and operational review and assessment provides an opportunity to enhance the future operability of the WWTP.
- The overall effectiveness of the project and the receptiveness of plant staff to the evaluation team recommendations are greatly impacted by the NCOIC for the WWTP. At Shaw AFB the WWTP Environmental Study was given a great deal of impetus by SMSgt. Pete Navin. His efforts provided momentum throughout the project. His initiatives as well as key members of the plant staff resulted in the implementation of many project recommendations.

APPENDIX A
SUMMARY OF RECORDKEEPING REQUIREMENT
FOR LAND APPLICATION OF SLUDGE

A Plain English Guide to the EPA Part 503 Biosolids Rule



Recordkeeping and Reporting Requirements

Part 503 requires that certain records be kept by the person who *prepares* biosolids for application to the land and the person who *applies* biosolids to the land. The recordkeeping and reporting requirements are summarized in Table 2-8. Some of the records that must be kept when biosolids are applied to the land include statements certifying whether certain land application requirements are met. The general certification statement that must be used is provided as Figure 2-10. This statement certifies that, among other things, the land applicer and his or her employees are qualified to gather information and perform tasks as required by the Part 503 rule.

The certifier should periodically check the performance of his or her employees to verify that the Part 503 requirements are being met. Then, when a Federal or State inspector checks the employee's logs, office records, and performance in the field, the inspector should find that the required management practices are being followed and that any applicable pathogen and vector attraction reduction requirements, including associated crop harvesting, animal grazing, and site access restrictions, are being met. The inspector also should find that all other necessary records and requirements listed in Table 2-8 are in order. Even if the preparer/applier is not required to report this information, he or she must keep these records for 5 years, or indefinitely for cumulative amounts of pollutants added to any site by CPLR biosolids. These required records may be requested for review at any time by the permitting or enforcement authority.

FIGURE 2-10
Certification Statement Required for Recordkeeping

"I certify under penalty of law, that the *[insert each of the following requirements that are met: Class A or Class B pathogen requirements, vector attraction reduction requirements, management practices, site restrictions, requirements to obtain information]* in *[insert the appropriate section number/s in Part 503 for each requirement met]* have/have not been met. This determination has been made under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate the information used to determine that the requirements have been met. I am aware that there are significant penalties for false certification, including the possibility of fine and imprisonment."

Signature _____

Date _____

TABLE 2-8
Recordkeeping and Reporting Requirements

Type of Biosolids	Records That Must Be Kept	Person Responsible for Recordkeeping		Records That Must Be Reported ^a
		Preparer	Applier	
EQ Biosolids	Pollutant concentrations	✓		✓
	Pathogen reduction certification and description	✓		✓
	Vector attraction reduction certification and description	✓		✓
PC Biosolids	Pollutant concentrations	✓		✓
	Management practice certification and description		✓	
	Site restriction certification and description (where Class B pathogen requirements are met)		✓	
	Pathogen reduction certification and description	✓		✓
	Vector attraction reduction certification and description	✓	✓ ^b	✓ ^c
CPLR Biosolids	Pollutant concentrations	✓		✓
	Management practice certification and description		✓	
	Site restriction certification and description (if Class B pathogen requirements are met)		✓	
	Pathogen reduction certification and description	✓		✓
	Vector attraction reduction certification and description	✓	✓ ^b	✓ ^c
	Other information: — Certification and description of information gathered (information from the previous applier, landowner, or permitting authority regarding the existing cumulative pollutant load at the site from previous biosolids applications) — Site location — Number of hectares — Amount of biosolids applied — Cumulative amount of pollutant applied (including previous amounts) — Date of application		✓	✓ ^d
APLR Biosolids	Pollutant concentrations	✓		✓
	Management practice certification and description	✓		✓
	Pathogen reduction certification and description	✓		✓
	Vector attraction reduction certification and description	✓		✓
	The AWSAR for the biosolids	✓		✓

^a Reporting responsibilities are only for POTWs with a design flow rate equal to or greater than 1 mgd, POTWs that serve a population of 10,000 or greater, and Class I sludge management facilities.

^b The preparer certifies and describes vector attraction reduction methods other than injection and incorporation of biosolids into the soil. The applier certifies and describes injection or incorporation of biosolids into the soil.

^c Records that certify and describe injection or incorporation of biosolids into the soil do not have to be reported.

^d Some of this information has to be reported only when 90 percent or more of any of the CPLRs is reached at a site.

Some facilities are not subject to any Part 503 reporting requirements. However, all Class I treatment works, treatment works serving a population of 10,000 or more, and treatment works with a 1 mgd or greater design flow (as described in the first chapter of this guidance) have reporting responsibilities. Each year, facilities with reporting requirements must submit some of the information contained in their records (according to Table 2-8). The information must be submitted every February 19th to the permitting authority (either EPA or a State with an EPA-approved biosolids management program).